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# Sleep and behavior of preschool children under typical and nap-promoted conditions

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ABSTRACT

*Background:* Children transition out of naps in early childhood. However, there is disagreement about when this transition should occur.
*Aims:* We compared measures of sleep and behavior in children divided into *Frequent, Sometimes, and Rarely* nappers to determine what factors predict when napping should cease. We then examined the effect of an experimenter-promoted nap on measures of sleep and behavior.
*Methods:* We studied 133 children (50.4% female; mean = 52.77 months) over 16 days. Parents completed questionnaires, whereas children wore actigraphs. On 1 study day, children were nap-promoted.
*Results:* Overnight sleep duration was significantly less for children who napped frequently than those who rarely napped, yet total 24-hour sleep and other sleep parameters did not differ across napping groups. Effortful control was marginally greater in those who rarely napped. Nap promotion was 91% successful across nap groups. When typical sleep was compared with sleep following a promoted nap, frequent nappers slept more on the nap-promoted night. Total 24-hour sleep increased in all children following the promoted nap, and other sleep parameters did not differ between groups.
*Conclusions:* The emergence of self-regulatory behaviors may predict when children should cease napping, consistent with the hypothesis that transitioning out of naps may be related to brain maturation. Given previously reported benefits of sleep on cognition and the observed increase in 24-hour sleep following nap promotion, nap promotion may benefit early education. Further research should explore maturational cues that illuminate when children are ready to transition out of napping.


## Introduction

A number of recent studies support the benefit of naps on learning and emotional regulation in preschool children. For instance, we have reported that declarative memories are consolidated over naps, with recall of learning from the morning ~10% greater following a nap compared with when children stay awake during naptime.[1] Likewise, children are less biased toward emotional stimuli following a nap,[2] and emotional regulation is greater following a nap compared with nap deprivation.[3,4] Moreover, naps at this age are rich in sleep spindles and slow wave sleep,[1] which are features of sleep associated with cognitive benefits in children[1,2] and young adults.[5–8]

Given these benefits, naps may promote the goals of early education settings. However, this raises the perennial question of when a child "grows out" of napping. Nap duration decreases around 3-4 years of age,[9–11] which coincides with the commencement of more adult-like sleep architecture.[12,13] The transition from biphasic (2 sleep bouts/day) to monophasic (1 sleep bout/day) sleep patterns has been suggested to reflect brain maturation.[14] Consistent with this, memory decay over wake is slower in those who do not nap habitually compared with habitually napping children,[1] suggesting more efficient processing or capacity. Brain development may also contribute to the maturation of homeostatic processes, thereby slowing the accumulation of sleep pressure.[15]

Although assessing brain maturation remains out of reach for parents and classroom teachers, behaviors may indicate the transition to monophasic sleep. For example, delayed nap onset may provide indication that the child has outgrown napping.[16] Furthermore, infrequent naps were associated with the emergence of effortful control (EC) and more "adult-like" cortisol patterns in 3-year-old children,

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which could reflect brain maturation.[17] Habitual daytime napping in early childhood may also be responsible for immature cortisol level patterns.[18] Alternatively, Ward and colleagues[19] suggest that the length of overnight sleep duration dictates nap habits, with sleep <10 hours as an indicator of nap need. More recently, a review by Thorpe and colleagues[20] suggested that a specific age (2 years) may be a marker of when naps become costly, reducing overnight sleep.

It is important to systematically examine what factors influence whether children nap habitually. In the current study, we examined whether typical overnight sleep is greater for non–habitually napping children compared with those who nap habitually or frequently as suggested by others.[19,20] In addition, we assessed whether there were differences in other sleep parameters (eg, sleep efficiency, sleep latency) for non–habitually napping children compared with habitual or frequent nappers, which would support the hypothesis that naps are detrimental to overnight sleep.[20]

Second, to elucidate biological factors that predict the cessation of napping, we examined behavioral measures that reflect brain maturation. Nonhabitual nappers, for example, may exhibit higher EC,[17] lower bedtime resistance,[16] and higher IQ,[14] all of which have been suggested to reflect maturation of cognitive and homeostatic processes, thus reducing the need for a nap.[14,15]

Finally, to evaluate the consequences or benefits of a nap on overnight sleep, we compared the child's sleep parameters following classroom nap promotion with their typical overnight sleep patterns. Although there may be reductions in overnight sleep after napping (eg,[20]), total sleep duration within a 24-hour period may not change.[19,21] Conversely, the lack of change in total 24-hour sleep duration between napping children and nonnapping children could reflect maturational changes in homeostatic processes, which dictate how quickly sleep pressure accumulates, thereby resulting in the need for a nap.[15]

## Methods

### Participants

Participants were 137 children with ≥5 days of usable actigraphy data (68 female; mean = 52.77 months; SD = 10.02) recruited from local preschools in western Massachusetts as part of a larger study of sleep and cognition. Children were eligible to participate if they met the following criteria: (*a*) aged 33-71 months; (*b*) normal or corrected-to-normal vision and hearing; (*c*) no current or past diagnosis of a sleep disorder or developmental disability;(*d*) not using sleep-effecting or psychotropic medications; and (*e*) had not traveled outside of local time zone in the week before the study.

### Measures

#### Actigraphy

The Actiwatch Spectrum (Philips Respironics, Bend, OR) is a water-resistant, wrist-worn device with off-wrist detection and triaxial accelerometer to measure motion. Data collected by the actigraph were stored in the internal memory of the device and subsequently downloaded to a computer for analysis.

#### Child sleep diaries

To aid in actigraphy scoring, caregivers were given a daily sleep diary to record any nap periods in the home, periods where the watch was taken off, time the child was in bed, time it took the child to fall asleep, and wake time. Classroom teachers were given a nap diary for each participating child and instructed to make note of whether children napped or not in the classroom during the 16-day study window.

#### Child Sleep Habits Questionnaire

The Child Sleep Habits Questionnaire (CSHQ)[22] was used to provide a subjective measure of children's sleep habits during a typical week. Of interest to the current study were items pertaining to bedtime resistance, specifically "Child resists going to bed at bedtime," "Child struggles at bedtime," and "Child falls asleep within 20 minutes after going to bed." Caregivers rated items on a 3-point scale: *Usually* (5-7 days per week), *Sometimes* (2-4 days per week), and *Rarely* (0-1 days per week). The CSHQ is a reliable measure of sleep problems in community and clinical samples (Cronbach's alpha = 0.68 and 0.78, respectively; Owens et al., 2000) and has established clinical utility in preschool children.[23]

#### Peabody Picture Vocabulary Test, 4th Edition

The Peabody Picture Vocabulary Test, 4th Edition (PPVT-IV),[24] is a proxy for IQ in children that is thought to be reflective of brain maturation.[14,25] The PPVT-IV is a norm-referenced scale that evaluates vocabulary acquisition by measuring understanding of a spoken word in standard American English. Children were presented with 4 full-color pictures on a page and asked to point to the picture that represents a particular word spoken by the experimenter. The PPVT-IV consists of 228 test items divided into 19 test sets. Children progressed through each set until committing a certain number of errors. Raw score totals were used for analyses.

#### Child Behavior Questionnaire

The Child Behavior Questionnaire (CBQ)[26] was used to assess temperament on 3 broad scales. We used an abbreviated form of the CBQ (ie, CBQ–Very Short Form) comprised of 36 items. Of interest in this study, items probing EC included: "When drawing or coloring in a book shows strong concentration"; "Notices it when parents are wearing new clothing"; and "Approaches places s/he has be told are dangerous slowly and cautiously." The EC scale has been shown to correspond with the development of executive functions, such as inhibitory control and sustained attention (eg, go/no-go tasks) in children.[27–29] For each question, caregivers rated the likelihood of behaviors occurring within the past 6 months on a 7-point Likert ranging from 1 (*Extremely Not True*) to 7 (*Extremely True*). Caregivers rated items that did not apply to their child as *Not Applicable*, and these items were not included when calculating the child's score for EC. The CBQ–Very Short Form subscale for EC is significantly correlated with that reported by the full CBQ ($r = 0.83$; see Putnam and Rothbart[26]). Raw scores for the EC scale were used for analyses.

### Procedure

Procedures were approved by the University of Massachusetts Amherst's Institutional Review Board. Caregivers provided written informed consent for their own and their child's participation, and child assent was obtained before procedures commenced. On day 1, actigraphs were distributed to participating children. The actigraph was fitted to the nondominant wrist, and caregivers and children were instructed to press a button (an event marker) at the start and end of daytime and nighttime sleep opportunities. Caregivers were asked to encourage their child to wear the actigraph continuously for the subsequent 16 days (15 nights). At the same time, questionnaires and diaries were given to parents to complete at any point during the study. Teachers completed nap diaries for the weekdays that children were in the classroom, which were used to corroborate actigraphy-recorded weekday naps.

On 1 of the 16 days, children were nap-promoted during the classroom nap opportunity (approximately 1-3 PM). Children were encouraged to nap through verbal encouragement ("Today is nap day. Try to sleep.") and typical classroom sleep promotion techniques